ZINC IN ROCK SAMPLES
(atomic-absorption determinations)

OPEN-FILE REPORT
81-728-F
SHEET 1 OF 4
FOLIO OF THE BRADFIELD CANAL QUADRANGLE, ALASKA
KOCH AND ELLIOTT--GEOCHEMISTRY- Zn

Base from USGS 1:250,000 topo series: Bradfield Canal, 1955, ALASKA-CANADA.

ROCK SAMPLES

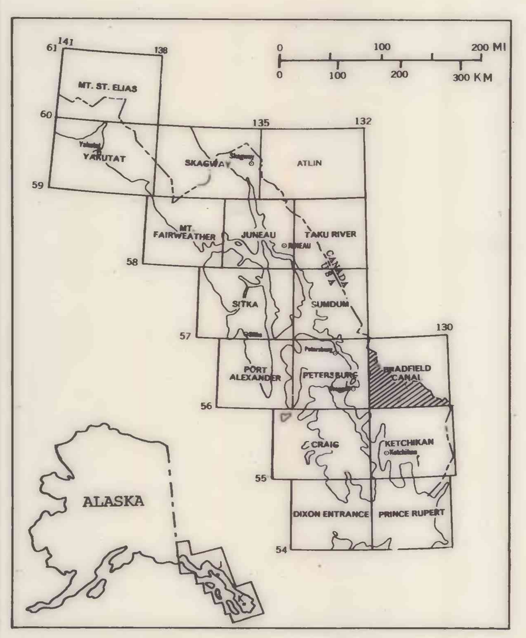
Geology by H. C. Berg, D. A. Brew, A. L. Clark, W. H. Condon, J. E. Decker, M. F. Diggles, G. C. Dunne, R. L. Elliott, J. D. Gallinatti, M. H. Herdrick, S. M. Karl, R. D. Koch, M. L. Miller-Hoare, R. P. Morrell, J. G. Smith, and R. A. Sonnevil, 1968-1979.

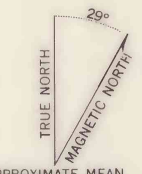
SCALE 1:250 000

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL





APPROXIMATE MEAN DECLINATION, 1955

KEY TO LITHOLOGY GROUP SYMBOLS

A - ALKALI-FELDSPAR GRANITE - includes related dikes

B - BASALT and ANDESITE - includes dikes and flows, and lamprophyre dikes

C - CALCSILICATE and SKARN

D - DIORITE and GABBRO - includes minor metadiorite, hornblendite, and ultramafic rocks

F - FELSITE - some quartz-porphyritic. Includes dikes, flows(?), and breccias

G - GRANITIC ROCKS - mainly massive and foliated quartz monzonite, granodiorite, and quartz diorite, with lesser alaskite, aplite, and pegmatite

H - HORNBLENDE-RICH SCHIST and GNEISS - includes amphibolite, greenschist, and other mafic metamorphic rocks

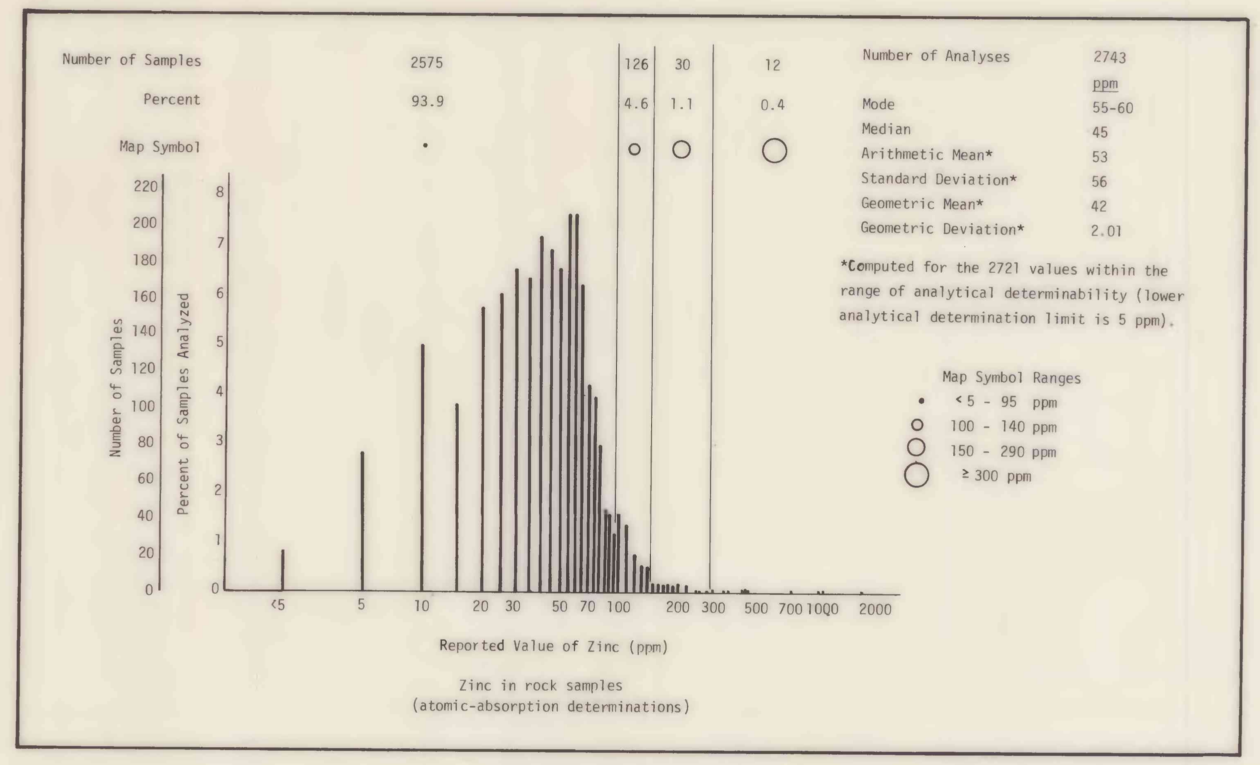
M - MIGMATITE and ORTHOGNEISS - includes granitic gneiss (eg: granodiorite gneiss, quartz diorite gneiss, etc.)

S - SCHIST and GNEISS - mainly pelitic and quartzofeldspathic schist and gneiss, and lesser non-schistose metasedimentary rocks

V - VEINS

Unit Descriptions

Qu	UNCONSOLIDATED DEPOSITS, UNDIVIDED (Quaternary)
QT_b	BASALT (Quaternary and Tertiary?)
Tgr	ALKALI-FELDSPAR GRANITE WITH ASSOCIATED QUARTZ-PORPHYRITIC RHYOLITE DIKES AND FLOWS(?) (Miocene?)
Tgb	BIOTITE-PYROXENE GABBRO, LOCALLY CONTAINS HORNBLENDE AND/OR OLIVINE (Miocene)
Telg	LEUCOCRATIC QUARTZ MONZONITE AND GRANODIORITE (Eocene)
Tegq	GRANODIORITE AND QUARTZ DIORITE (Eocene)
Tq	QUARTZ DIORITE (Eocene or Paleocene)
TKlg	LEUCOCRATIC QUARTZ MONZONITE AND GRANODIORITE (Tertiary and/or Cretaceous)
TKgq	GRANODIORITE AND QUARTZ DIORITE (Tertiary and/or Cretaceous)
Kgq	BIOTITE-HORNBLENDE QUARTZ DIORITE, PLAGIOCLASE-PORPHYRITIC BIOTITE GRANODIORITE/QUARTZ DIORITE, BOTH LOCALLY CONTAIN GARNET AND/OR EPIDOTE (Cretaceous)
ꞦRt	TEXAS CREEK GRANODIORITE (Triassic)
MzPzmg	MIGMATITE AND ORTHOGNEISS, WITH LESSER PARAGNEISS (Mesozoic and/or Paleozoic)
MzPzpo	PARAGNEISS AND ORTHOGNEISS, WITH LESSER AMPHIBOLITE AND MARBLE (Mesozoic and/or Paleozoic)
MzPzsp	SCHIST AND PARAGNEISS, WITH LESSER AMPHIBOLITE AND MARBLE (Mesozoic and/or Paleozoic)
MzPzsv	METASEDIMENTARY AND LESSER METAVOLCANIC ROCKS, WITH LOCAL MARBLE (Mesozoic and/or Paleozoic)



Zinc in rock samples
(atomic-absorption determinations)

Discussion

During U.S. Geological Survey investigations in the Bradfield Canal quadrangle between 1968 and 1979, 2784 rock geochemical samples, 1295 stream-sediment samples, and 219 stream-sediment heavy-mineral concentrate samples were collected. The samples were analyzed for up to 31 elements by a 6-step, semi-quantitative emission spectrographic method (Grimes and Marranzino, 1968) and for up to 5 elements by atomic-absorption techniques (Ward and others, 1969). Complete analytical data for all samples, plus location maps, station coordinates, and a discussion of sampling and analytical procedures are available in 3 reports (Koch and others, 1980a,b,c). These data are also available on magnetic computer tape (Koch, O'Leary, and Risoli, 1980).

Maps on this and the accompanying sheets show the amounts of zinc (Zn) detected in all geochemical samples collected in the Bradfield Canal quadrangle. Zinc analyses for most samples were done by both the 6-step spectrographic and the atomic-absorption methods. The spectrographic analytical values are reported as the approximate midpoints of geometrically spaced class intervals, with values in the series 1, 1.5, 2, 3, 5, 7, 10, 15, 20, ... (see Koch and others, 1980a,b,c, Grimes and Marranzino, 1968). Each of these reporting values is referred to as a "step" on the reporting scale. Analytical values from atomic-absorption analyses are reported at intervals of 5 ppm for values between 5 and 100 ppm, and at intervals of 10 ppm for values above 100 ppm.

Because of the high detection limits for spectrographic Zn analyses, only 72 of the rock samples, 19 of the stream-sediment samples, and one of the heavy-mineral concentrate samples with unqualified atomic-absorption values, also have Zn detectable by the spectrographic method. For these samples, spectrographic and atomic-absorption analytical results for Zn tend to be somewhat different, with the spectrographic values averaging 2.5 steps higher for rock samples, and almost 1 step higher for stream-sediment samples. The sources of these differences have not been rigorously identified, but several factors probably contribute.

Atomic-absorption analyses have lower analytical determination limits and are considered to have greater precision than the spectrographic analyses (Richard M. O'Leary, personal communication, 1980, Koch and others, 1980a,b,c, Motooka and Grimes, 1976). The nitric acid partial digestion used for atomic-absorption analyses dissolves sulfides and oxides, but only extracts metals from the surface of silicate grains. Thermal excitation during spectrographic analysis causes spectral emission from all Zn in the sample. The general shift of spectrographic values higher than atomic-absorption values may thus be partly the result of background levels of Zn in silicates being detected by the spectrographic analysis but not being extracted in the atomic-absorption partial digestion. An additional, nonsystematic source of discrepancy between the analyses may be sample inhomogeneity. Different fractions are used for the two analyses and only a small amount of sample, (0.01 g for rock and stream-sediment samples, 0.005 g for concentrate samples) is used for the spectrographic analyses.

Average geochemical abundances vary for different lithologies and in different areas. The degree of chemical weathering also affects the elemental abundances, although probably with minor effect in this recently glaciated terrain. Analytical variance and variations in sampling practice limit the repeatability of these results. Complex interactions between these sources of variation make it impossible to select a single threshold value which will discriminate between areas which are barren and areas with potentially valuable mineral concentrations.

In order to estimate which analytical values are sufficiently above general background levels to warrant further interest, the following procedure was followed for each sample type. Histograms of the data were examined for apparent breaks (discontinuities or abrupt changes in level) in the distribution. A cutoff value was selected at an arbitrarily chosen level near the 95th percentile or at a break close to that level when one was present. The geographic distribution of the samples above the cutoff level was examined for clumping and scatter. The cutoff level was adjusted up or down to minimize apparent geographic scatter ("noise").

Samples in which the Zn content was above the cutoff level are marked by one of three sizes of circles. Each circle size represents a range of analytical values, with larger circles indicating higher values. Samples in which the Zn content was below the cutoff level are indicated on the map by dots. The range, number, and percentage of values associated with each map symbol are indicated on the corresponding histogram. Higher values may indicate a greater likelihood of bedrock mineralization, but confidence levels are low for values near analytical limits of determinability, for single-element anomalies, for samples where atomic-absorption and spectrographic results are not both high, and for results not supported by high values in nearby samples.

Each rock sample was assigned to one of ten broad lithologic groups of similar rock types on the basis of the rock name given to the sample at the time that it was collected. The types of rocks included in each of the groups are summarized in the table labelled "Key to Lithology Group Symbols". On the map, circles representing rock samples with Zn content above the cutoff value are labelled with the letter indicating the lithology group for that sample.

Average abundance* of zinc (in ppm) in the Earth's crust and various crustal components. (From Levinson, 1974)

	Earth's crust	Ultra-mafic	Basalt	Grano-diorite	Granite	Shale	Lime-stone	Soil
Zn	70	50	100	60	40	100	25	10-300

*Note: Because the analyses on which these averages are based may not be directly compatible with the analyses used for this report, these figures serve only as a general guide.

In the Bradfield Canal quadrangle, most of the known prospects in which zinc is reported are in the area near Texas Creek and the Salmon River, at the southeastern corner of the quadrangle. In this area, zinc occurs in sphalerite (ZnS) and is commonly associated with galena, pyrite, chalcopyrite and sometimes with silver. Deposits are mainly within metamorphic rocks as quartz veins, with some disseminated deposits and sulfide veins and lenses. There is one reported occurrence of sphalerite in a prospect north of Berg Mountain near the western edge of the quadrangle. Just west of the quadrangle, in the areas in and around Berg, Glacier, and Groundhog Basins, sphalerite occurs with other sulfides and some silver and gold, as massive and disseminated deposits, and in quartz-carbonate veins.

Zinc values above the cutoff levels for both atomic-absorption and spectrographic analyses of rock samples form two major concentrations on the map. The densest of these is in and around unit Tgr near Cone Mountain, southwest of boundary peak Mount Whipple. Here, Zn is concentrated mainly in alkali-granite and felsite. High values in other lithologies within the area of unit Tgr may represent contamination from the mid-Tertiary felsic rocks. Values above the cutoff levels, especially from atomic-absorption analyses, are common throughout much of unit MzPzsp on either side of Bradfield Canal. Several small clusters of high values occur in other metamorphic units, MzPzpo and MzPzsv, but not with the density seen in MzPzsp. The only pre-mid-Tertiary granitic body with an appreciable cluster of Zn values is the body of Kgq at Martin Lake. This locally garnet-bearing stock, is crudely zoned with equigranular biotite-hornblende quartz diorite on the west and plagioclase-porphyritic biotite quartz diorite on the east. It is lithologically dissimilar to rocks included in Kgq on Wrangell Island and south of Bradfield Canal. The origin of these Zn values is unknown.

Atomic-Absorption Zinc Values At and Above 100 ppm

Lithology	Sample	Percent	Geometric Mean	Range
Metamorphic Rock	76	45	125 ppm	100 - 300 ppm
Mafic Meta. Rock	11	7	180	100 - 1700
Granitic Rock	34	20	115	100 - 190
Felsite	24	14	165	100 - 340
Alkali-granite	9	5	190	100 - 1030
Skarn	3	2	265	120 - 420
Vein	1	1	--	450
Other	10	6	185	100 - 760

Spectrographic Zinc Values At and Above 200 ppm

Lithology	Sample	Percent	Geometric Mean	Range
Metamorphic Rock	23	30	280 ppm	200 - 1000 ppm
Mafic Meta. Rock	9	11	445	200 - 3000
Granitic Rock	7	9	225	200 - 300
Felsite	19	24	325	200 - 300
Alkali-granite	5	6	426	200 - 1000
Skarn	6	8	385	200 - 700
Vein	3	4	420	300 - 500
Other	6	8	370	200 - 700

Zinc values above spectrographic and atomic-absorption cutoff levels for stream-sediment samples form several small clusters on the map within unit MzPzsp. Nearly half of the samples from within unit Tgr have atomic-absorption Zn values above the cutoff. Spectrographic values show clusters along Texas Creek and the east side of the Salmon River (where no atomic-absorption analyses were done).

Only one of the spectrographic analyses of heavy-mineral concentrate samples reported Zn above the 500 ppm detection limit. This sample was from within unit MzPzsv, just north of unit Tgr. Most of the samples with Zn above the atomic-absorption cutoff level cluster in unit Tgr and within unit MzPzsv just north of Tgr.

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MAPS SHOWING DISTRIBUTION AND ABUNDANCE OF ZINC IN GEOCHEMICAL SAMPLES FROM THE BRADFIELD CANAL QUADRANGLE, SOUTHEASTERN ALASKA

by

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1981